Credit: NASA

Photo: Claire Fackler, NOAA National Marine Sanctuaries

Credit: NOAA National Marine Sanctuaries

Climate Literacy
Concepts, Talking Points, and Case Studies

Introduction

Scientists agree the climate is changing. How these changes will effect the globe is still uncertain and many people do not understand what is happening and how people are involved. Human activities have had a profound influence on the Earth's climate. Changes are evident, such as coastal erosion, extreme storm events, flooding, increased wildfires, sea level rise and droughts. Scientific observations and climate model results indicate that human activities are now the primary cause of most of the ongoing increase in Earth's globally averaged surface temperature (Climate Literacy: The Essential Principles of Climate Sciences, 2009). Climate change will bring economic and environmental challenges as well as opportunities, and citizens who have an understanding of climate science will be better prepared to respond to both (Climate Literacy: The Essential Principles of Climate Sciences, 2009). Therefore, it is essential for humanity to understand how changes in climate may impact the Earth, our quality of life and ultimately, our survival.

One way to achieve this is by incorporating climate literacy into what we do everyday. People who are climate science literate know that climate science can inform our decisions to improve quality of life. They have a basic understanding of the climate system, including the natural- and human-caused factors that affect it. Climate science literate individuals are aware of the fundamental relationship between climate and human life and the many ways in which climate has always played a role in human health. (Climate Literacy: The Essential Principles of Climate Sciences, 2009)

The NOAA Office of National Marine Sanctuaries Education Team has reviewed the climate literacy principles and concepts to determine what elements are mission critical for the sanctuary system to communicate. This document outlines the seven mission critical concepts that were identified, and provides sanctuary-specific talking points and sanctuary-related case studies that support each concept. Each talking point describes how the issue affects the National Marine Sanctuary System. Whereas the case studies are brief examples of what we are doing about the issue, such as how we are addressing the issue or learning more about it.

It is intended that these climate literacy messages and talking points will be incorporated as appropriate into the education and outreach programs and products of the National Marine Sanctuary System. These messages are not only put forth for the education team's use, all staff within the NOAA Office of National Marine Sanctuaries will be encouraged to communicate these messages and talking points for consistency among our sanctuary system. Examples include incorporating these messages, talking points and case studies into a presentation you are giving, or integrating them into exhibits and signage as necessary and appropriate.

If you have any questions or concerns about the climate literacy messages and talking points, please contact the chairs of the Ocean and Climate Literacy Working Group: Claire.Fackler@noaa.gov and Shannon.Ricles@noaa.gov.

Understanding How This Documents Works

Climate Literacy Concepts

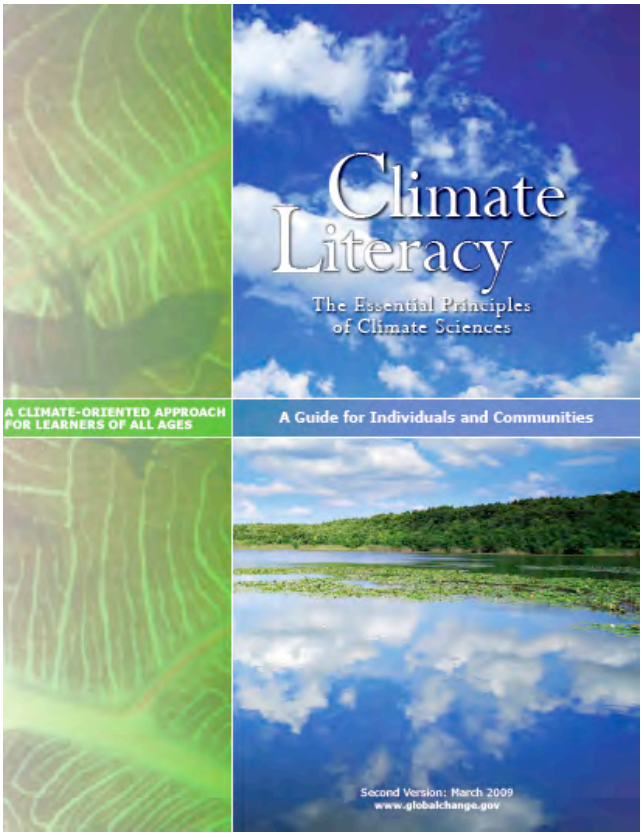
Highlighted in this box are the mission critical climate literacy concepts. These concepts are taken verbatim from the Climate Literacy: The Essential Principles of Climate Sciences, 2009.

Sanctuary-Specific Talking Point

1. Each talking point describes how the issue affects the National Marine Sanctuary System. It is important to note that talking points are pieces of information that explain key messages or concepts, answer potential questions and provide specific facts and figures to back up your messages or concepts. Talking points may be used in conversation, when speaking to the public or incorporated into written materials.

Possible Sanctuary-Related Case Studies *(Each field site should create their own case studies as appropriate. These are just a few examples provided below.)*

- These case studies are brief examples of what NOAA and the National Marine Sanctuary System are doing about the issue, such as how we are addressing the issue or learning more about it. Guidance from "Doing Our Part as Leaders in Conservation," about the greening of the NOAA Office of National Marine Sanctuaries suggests we should "tell the story of how climate changes are manifesting in the sites (i.e. in the community's back yard), including impacts on maritime heritage and natural resources, and both the natural and socioeconomic impacts." Case studies are these "stories." These case studies are not intended to be fully flushed out, and in most cases the intent is for each national marine sanctuary field site to develop out their own sanctuary-related case studies that tell the story about their site or region.



Credit: NASA images by Reto Stöckli. Bathymetry images are derived from the General Bathymetric Chart of the Oceans Digital Atlas

General Climate Change Theme and Messages

Overarching Theme: Changes in climate will impact national marine sanctuaries and the overall health of the ocean that is vital to our quality of life and ultimately, our survival.

1) Climate change is happening and human activities are contributing to and accelerating it.
2) Climate change has consequences for the ocean, including national marine sanctuaries, people and the planet.
3) Resource agencies around the world, including NOAA, are taking action to address climate change.
4) The choices all of us make may help to avoid catastrophic impacts now and in the future.

Climate Literacy Concept #2b

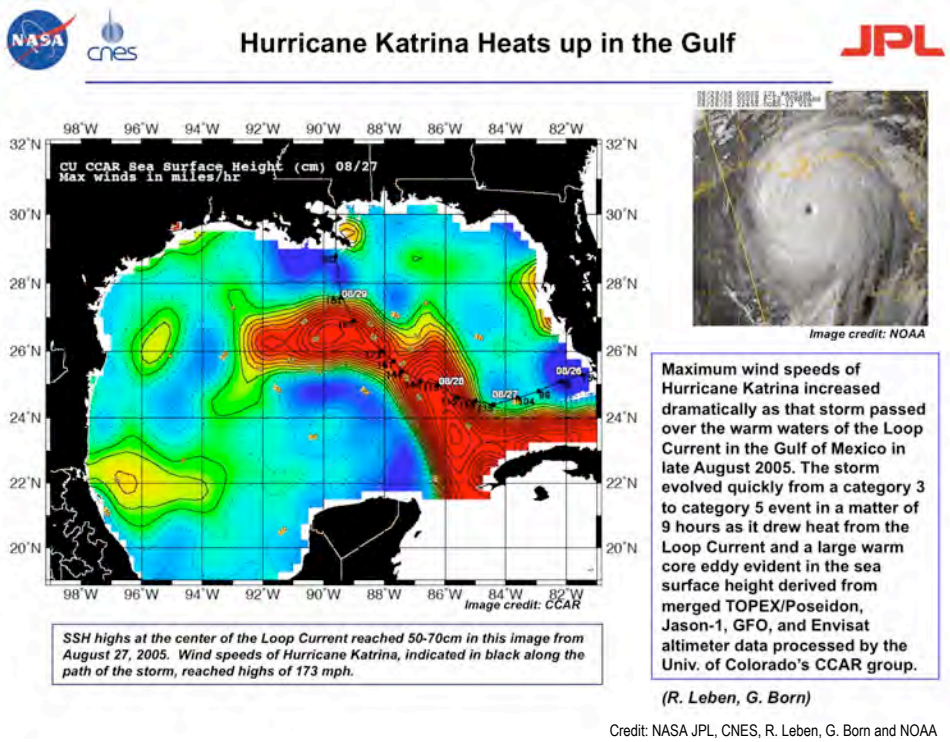
Covering 70% of Earth's surface, the ocean exerts a major control on climate by dominating Earth's energy and water cycles.

Sanctuary-Specific Talking Point

1. The ocean dominates the Earth's surface with national marine sanctuaries protecting less than 0.01% of ocean in U.S. waters, which is approximately 150,000 square miles of ocean. National marine sanctuaries are a small, yet important protected portion of the ocean that are affected by the changes in Earth's energy and water cycles.

Possible Sanctuary-Related Case Studies *(Each field site should create their own case studies as appropriate. These are just a few examples provided below.)*

- Hurricanes are becoming more impactful in national marine sanctuaries in Florida, Gulf of Mexico, Hawai`i, etc. Visit the National Hurricane Center at http://www.nhc.noaa.gov/ for more information about hurricanes.
- Changes in upwelling regimes have large biological affect on national marine sanctuaries along the West Coast.
- There have been unusual wind conditions in the Santa Barbara Channel. Since 1955, on average there have been three (3) additional windy days each year with winds in excess of 25 mph.



Credit: NASA JPL, CNES, R. Leben, G. Born and NOAA

Climate Literacy Concept #3a

Organisms exposed to climate conditions outside their normal range must adapt or migrate, or they will perish.

Sanctuary-Specific Talking Point

1. National marine sanctuaries are set aside to protect special ocean areas and critical habitats for future generations, and the impacts of climate change may alter their habitats, species composition and abundance.

Possible Sanctuary-Related Case Studies *(Each field site should create their own case studies as appropriate. These are just a few examples provided below.)*

- National marine sanctuaries strive to monitor changes that occur and use adaptive management to ensure the overall ecosystem health.

  Adaptation initiatives include:
  1) Climate Smart: a process to help each sanctuary plan and manage for climate change impacts;
  2) South Florida climatology project: an effort to integrate oceanographic and biological data to establish a climatological baseline at a local, MPA scale;
  3) ONMS climate curricula and training program, which provides climate change planning and adaptation training for MPA practitioners; and
  4) West Coast Ocean Acidification Action Plan.

- All West Coast sanctuaries contain deep-sea corals, and these corals may be affected by changes in ocean chemistry. They may also show special adaptations to lower acidity water. Research on deep-sea corals on the West Coast, funded by NOAA's Coral Reef Conservation Program, is aimed at understanding the abundance, distribution, ecology, and habitat requirements of these organisms.

- Coral bleaching — Corals are not mobile, so if they can't adapt to climate change (i.e. warmer and more acidic water) they will die off.

- Some of the National Marine Sanctuary System's Condition Reports state that the oxygen-minimum layer (150 ft. below of the surface on average) is expanding in certain areas (getting shallower).

Credit: iStockphoto.com/ThomasVogel

Climate Literacy Concept #6d

Growing evidence shows that changes in many physical and biological systems are linked to human-caused global warming. Some changes resulting from human activities have decreased the capacity of the environment to support various species and have substantially reduced ecosystem biodiversity and ecological resilience.

Sanctuary-Specific Talking Points

1. The current warming trend is of particular significance because scientific evidence suggests it is very likely human-induced. National marine sanctuaries are special ocean areas set aside as ecological hot spots where monitoring takes place to assess the impacts of ecological resilience and ecosystem biodiversity.

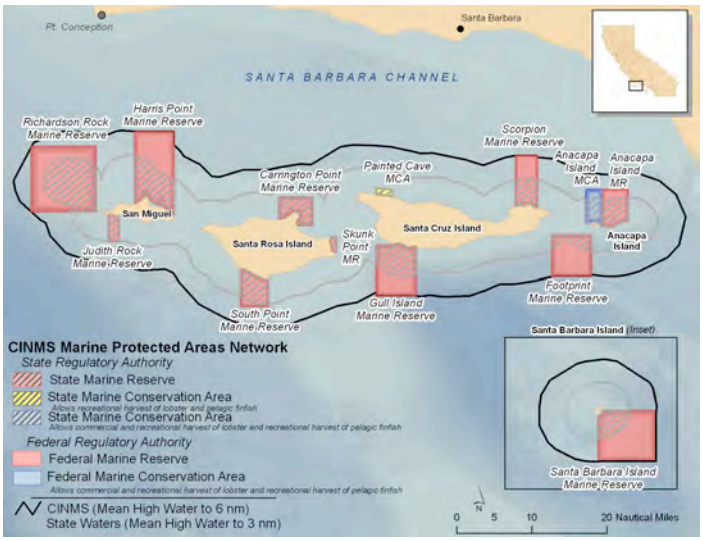
2. The National Marine Sanctuary System protects ecosystem biodiversity through conducting scientific research, monitoring programs, as well as education and outreach activities that support management.

Possible Sanctuary-Related Case Studies *(Each field site should create their own case studies as appropriate. These are just a few examples provided below.)*

- The National Marine Sanctuary System improves ecological resilience by establishing other ecosystem management tools (e.g., no-take marine reserves).

Photo: Jim Webb, National Geographic Media Camp, Ocean for Life 2011

Education and outreach is one of the ways the National Marine Sanctuary System protects ecosystem biodiversity.



Credit: NOAA Channel Islands National Marine Sanctuary

The network of marine reserves in Channel Islands National Marine Sanctuary helps to improve ecological resilience.

Climate Literacy Concept #7a

Melting of ice sheets and glaciers, combined with the thermal expansion of seawater as the ocean warms, is causing sea level to rise.

Sanctuary-Specific Talking Points

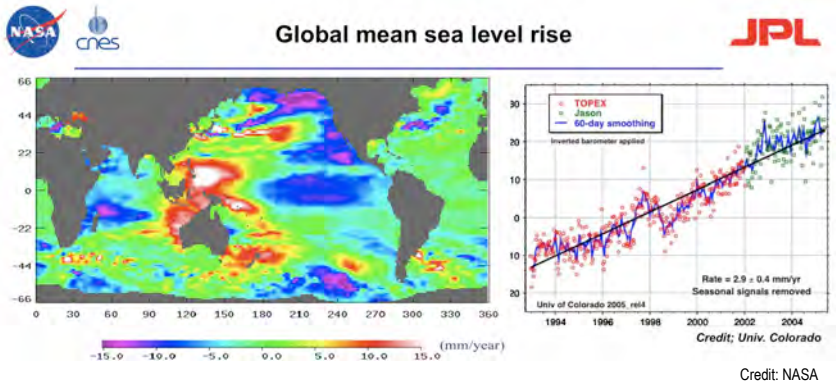
1. Rising sea level and flooding caused by heavy storms will affect the coastal ecosystems of national marine sanctuaries.

2. Rising sea level will affect coastal communities and infrastructure within national marine sanctuaries.

3. Increased storm frequency with increased intensity coupled with higher wave heights are making sea level rise more impactful to national marine sanctuary habitats and coastal communities.

Possible Sanctuary-Related Case Studies (Each field site should create their own case studies as appropriate. These are just a few examples provided below.)

- Rising sea level may flood/drown sensitive mangrove forests located in Florida Keys National Marine Sanctuary, and may cover low-lying islands in Papahanaumokuakea Marine National Monument.
- Rising sea level may encroach upon shorelines, further narrowing beaches and increasing erosion, which may impact seabird nesting and marine mammal haul-out sites in our national marine sanctuaries.
- "The ocean's fury is an omnipresent threat for the growing number of people who live at its edge. But accumulating scientific evidence suggest that our warming climate could cause sea levels to rise faster than previously thought, making storm surges like the one that pummeled Scituate more dangerous." The Boston Globe April 3, 2011 – Stellwagen Bank
- Rising sea level may cause damage to docks, boathouses and other coastal structures owned or operated by the National Marine Sanctuary System, as well as these things owned or operated by individuals and companies that use sanctuary resources (fishermen, whale watch companies, divers, etc.).
- Rising sea level may be verified at NOAA Tide Stations, some of which are found in or near National Marine Sanctuary System. For example, the NOAA Tide Station co-located with the Gulf of the Farallones National Marine Sanctuary at the dock has been collecting sea level data for 150+ years.



Credit: NASA

Climate Literacy Concept #7d

The chemistry of ocean water is changed by absorption of carbon dioxide from the atmosphere (ocean acidification). Increasing carbon dioxide levels in the atmosphere is causing ocean water to become more acidic, threatening the survival of shell-building marine species and the entire food web of which they are a part.

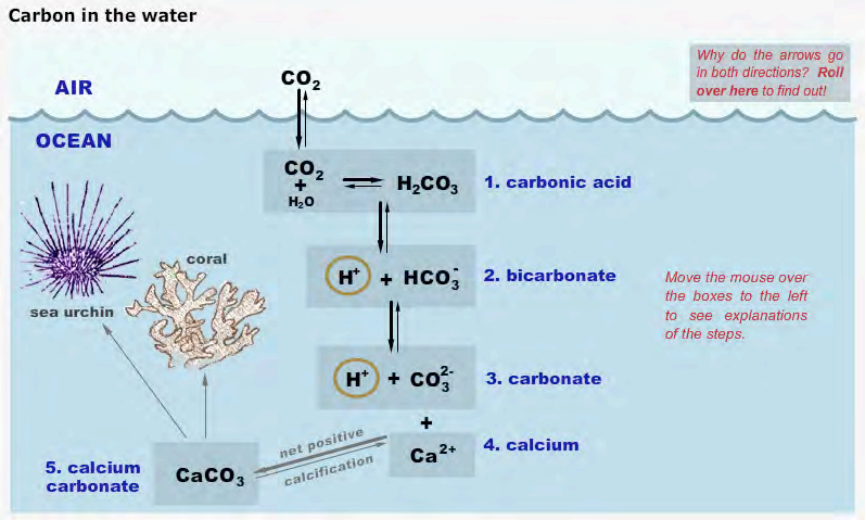
Sanctuary-Specific Talking Points

1. Ocean acidification has the potential to fundamentally change national marine sanctuary habitats, food webs and marine life. Research provides a baseline for monitoring change in sanctuary ecosystems and will help us better understand and respond to these emerging threats.

2. National marine sanctuaries are being promoted as sentinel sites (intensely monitored coastal and marine environments) to study impacts of ocean acidification.

Possible Sanctuary-Related Case Studies *(Each field site should create their own case studies as appropriate. These are just a few examples provided below.)*

- Many of the national marine sanctuaries have been targeted for ocean acidification research, which involves intensive monitoring of ocean systems. NOAA is playing a leading role in this research.
- Deep-sea coral research along the West Coast involves ocean acidification testing.
- PMEL West Coast ocean acidification cruises (2007, Aug-Sept 2011).
- All Sanctuary Advisory Councils adopted resolutions concerning ocean acidification.
- West Coast Ocean Acidification Action Plan.



Credit: Stanford University, Virtual Urchin Lab

Climate Literacy Action D

Humans may be able to mitigate climate change or lessen its severity by reducing greenhouse gas concentrations through processes that move carbon out of the atmosphere or reduce greenhouse gas emissions.

Sanctuary-Specific Talking Points

1. National marine sanctuaries are reducing the environmental footprint of our offices and facilities, and ensuring that our day-to-day operations are conducted in the most environmentally sound manner as possible.

2. National marine sanctuaries are informing communities about climate change and providing examples of conservation actions.

3. National marine sanctuaries are pioneering efforts to help marine protected areas and their communities adapt to climate change.

Possible Sanctuary-Related Case Studies *(Each field site should create their own case studies as appropriate. These are just a few examples provided below.)*

- The NOAA Office of National Marine Sanctuaries is leading the way in reducing our environmental footprint by using hybrid cars, organizing Webinars instead of face-to-face meetings, conducting rigorous recycling programs at facilities, installing solar panels for visitor centers, and obtaining LEED certification in all new buildings.
- Some NOAA Office of National Marine Sanctuaries vessels are being converted to biodiesel, and cruise plans are being reviewed to reduce carbon footprint.
- Stellwagen Bank National Marine Sanctuary's buildings are eco-friendly with geo-thermal heating and cooling, and the Florida Keys Eco-Discovery Center in Key West is run on clean solar energy.
- Gulf of the Farallones National Marine Sanctuary created the130 Strategy Green Operations Plan.
- Gulf of the Farallones and Fagatele Bay national marine sanctuaries are forefront in becoming Climate-Smart Sanctuaries.
- Florida Keys National Marine Sanctuary is a leader in helping coral reef managers around the world address coral bleaching. The Florida Keys sanctuary is also a pioneer in identifying the socioeconomic effects of climate change along with the natural impacts.
- Papahanaumokuakea Marine National Monument is developing a strategy for addressing climate change in the Pacific Ocean and Hawaiian Archipelago.

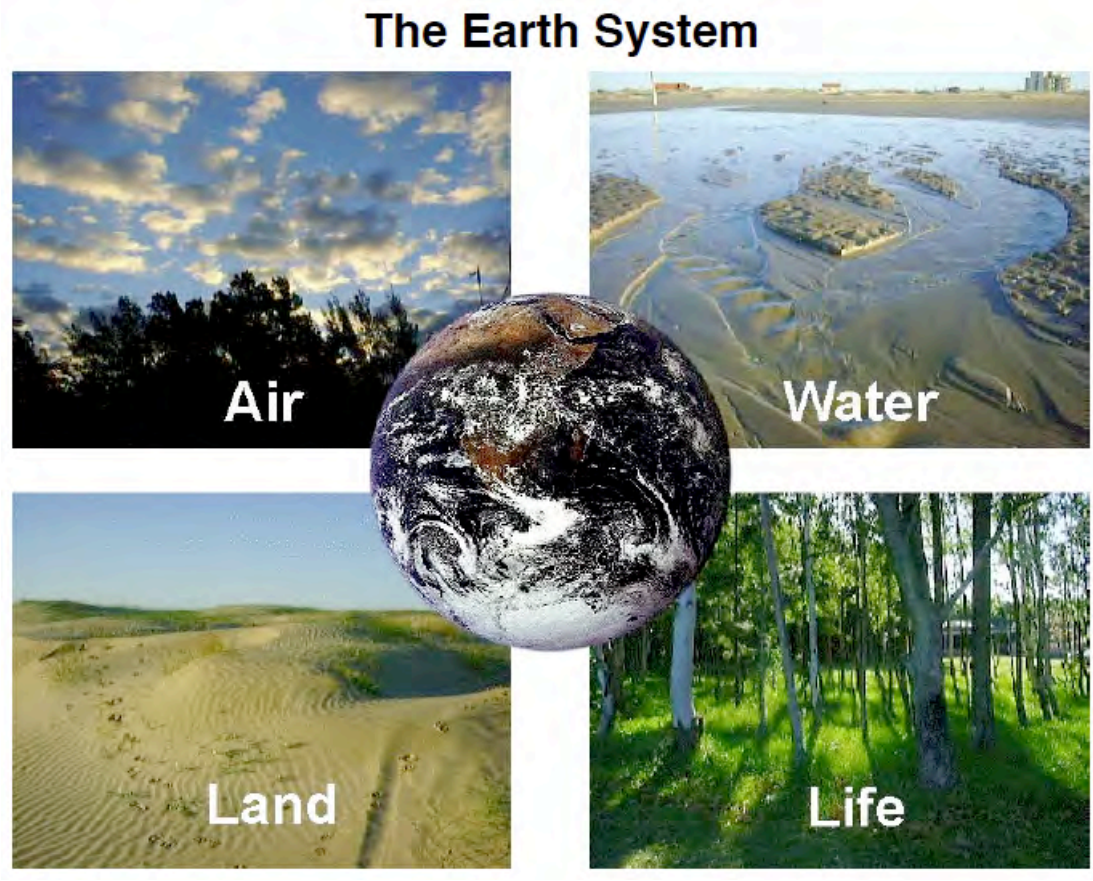
Climate Literacy Action D (*continued)*

Possible Sanctuary-Related Case Studies *(Each field site should create their own case studies as appropriate. These are just a few examples provided below.)*

- An example of how we have incorporated this information into our education and outreach with various target audience. In cooperation with NOAA Fisheries, Stellwagen Bank National Marine Sanctuary has partnered with area whale watching operators, to promote Whale SENSE, a voluntary education program that encourages them to reduce their carbon footprint. Whale SENSE is an outgrowth of Dolphin SMART in the Florida Keys National Marine Sanctuary.

- The Blue Star program in the Florida Keys National Marine Sanctuary.

- Gulf of the Farallones National Marine Sanctuary is collaborating with California Academy of Sciences on updating their climate change exhibit to include interpretive trail signs related to the impacts of climate change, and highlight action statements and other information.



Credit: National Park Service Climate Presentation

Climate Literacy Action G

Actions taken by individuals, communities, states, and countries all influence climate. Practices and policies followed in homes, schools, businesses, and governments can affect climate. Climate-related decisions made by one generation can provide opportunities as well as limit the range of possibilities open to the next generation.

Sanctuary-Specific Talking Points

1. The National Marine Sanctuary System utilizes our programs, partners and advisory councils to leverage our efforts to have a positive impact on sanctuary communities, regions, the nation, and the world.

2. The ocean influences weather and climate and is a vital resource that provides food, water, commerce, recreation, medicine and even the air we breathe. A healthy ocean impacts our quality of life, and is critical to human survival now and in the future.

Possible Sanctuary-Related Case Studies *(Each field site should create their own case studies as appropriate. These are just a few examples provided below.)*

- The Channel Islands National Marine Sanctuary Education Team held several workshops on communicating controversial issues like climate change and ocean acidification for Channel Islands Naturalist Corps volunteers and aquarium/information science center docents. This information helped inform the corps and docents about climate issues facing our ocean planet. An ocean acidification Web site with lots of resources has been developed; visit http://acidocean.org for more information.

- Get involved with national marine sanctuaries to do your part to address climate change.

Photo: Homemadesolarpanelsite.com

Photo: conserve-energy-future.com

Photo: conserve-energy-future.com